CLAIMS

WE CLAIM:

1. A controlled temperature, thermal-assisted magnetic memory device comprising:

    an array of SVM cells, the SVM cells characterized by an alterable orientation of magnetization and comprising a material wherein the coercivity is decreased upon an increase in temperature;

    at least one reference SVM cell; and

    a feedback controlled temperature controller receiving a reference voltage and further receiving a feedback voltage from the reference SVM cell when power is applied to the reference SVM cell and a selected array SVM cell to heat the reference SVM cell and the selected array SVM cell, the feedback controlled temperature controller adjusting the applied power to minimize the difference between the feedback voltage and reference voltage.

2. The controlled temperature, thermal-assisted magnetic memory device of claim 1, wherein the at least one reference SVM cell is substantially identical to the SVM cells of the array.

3. The controlled temperature, thermal-assisted magnetic memory device of claim 1, wherein the at least one reference SVM cell is positioned within close proximity to the array.

4. A controlled temperature, thermal-assisted magnetic memory device comprising:

    an array of SVM cells, the SVM cells characterized by an alterable orientation of magnetization and comprising a material wherein the coercivity is decreased upon an increase in temperature;

    at least one reference SVM cell substantially simiar to the SVM cells of the array, the reference SVM cell positioned within close proximity to the array; and

    a feedback controlled temperature controller receiving a reference voltage and receiving a feedback voltage from the reference SVM cell when power is applied to the reference SVM cell and a selected array SVM cell to heat the reference SVM cell and the selected array SVM cell, the feedback controlled temperature controller adjusting the applied power to minimize the difference between the feedback voltage and reference voltage.

5. The controlled temperature, thermal-assisted magnetic memory device of claim 4, wherein the at least one reference SVM cell is substantially identical to the SVM cells of the array.

6. The controlled temperature, thermal-assisted magnetic memory device of claim 4, wherein the ambient temperature of the reference SVM cell is substantially about the same as the ambient temperature of the array of SVM cells.

7. The controlled temperature, thermal-assisted magnetic memory device of claim 4, wherein the reference SVM cell is located within the array.

8. The controlled temperature, thermal-assisted magnetic memory device of claim 4, wherein the reference voltage represents a specific temperature.

9. The controlled temperature, thermal-assisted magnetic memory device of claim 4, wherein the reference voltage represents temperature for a reduced coercivity of the reference SVM cell.

10. The controlled temperature, thermal-assisted magnetic memory device of claim 4, wherein the feedback controlled temperature controller further includes a negative feedback differential amplifier receiving the reference voltage and the feedback voltage.

11. The controlled temperature, thermal-assisted magnetic memory device of claim 4, wherein the applied power is a heating power.

12. The controlled temperature, thermal-assisted magnetic memory device of claim 4, wherein the applied power is selected from a varying current, a varying voltage, or high frequency (RF) power, or laser power.

13. The controlled temperature, thermal-assisted magnetic memory device of claim 4, wherein the reference SVM cell and selected array SVM cell self-heat by the power flowing through the reference SVM cell and selected array SVM cell.

14. The controlled temperature, thermal-assisted magnetic memory device of claim 4, wherein the reference SVM cell and selected array SVM cell are heated by coupled heating, wherein heating power flows through a separated heating device thermally coupled to the reference SVM cell and selected array SVM cell.

15. The controlled temperature, thermal-assisted magnetic memory device of claim 4, wherein the array is a cross-point array including:

a plurality of parallel electrically conductive rows; and

a plurality of parallel electrically conductive columns crossing the rows, each thereby forming a cross-point array with a plurality of intersections;

wherein each SVM cell of the cross-point array is in electrical contact with and located at an intersection between a row and column.

16. The controlled temperature, thermal-assisted magnetic memory device of claim 4, wherein the reference SVM cell is thermally coupled to a temperature sensor.

17. The controlled temperature, thermal-assisted magnetic memory device of claim 16, wherein the reference SVM cell is physically coupled to the temperature sensor.

18. The controlled temperature, thermal-assisted magnetic memory device of claim 16, wherein the temperature sensor is a PN junction diode.

19. The controlled temperature, thermal-assisted magnetic memory device of claim 16, further including a circuit for heating a selected array SVM cell during a write operation on the selected array SVM cell, the circuit:

applying substantially the same power to the reference SVM cell and the selected array SVM cell;

sensing a feedback voltage from the temperature sensor coupled to the reference SVM cell;

adjusting the power applied to the reference SVM cell and the selected array SVM cell to minimize the difference between the feedback voltage and the reference voltage; and

applying a magnetic field to the selected array SVM cell;

wherein the orientation of magnetization of the selected array SVM cell may be changed, the magnetic field being greater than the coercivity of the heated selected array SVM cell.

20. A controlled temperature, thermal-assisted magnetic memory device comprising:

a plurality of parallel electrically conductive rows;

a plurality of parallel electrically conductive columns crossing the rows, thereby forming a cross-point array with a plurality of intersections;

a plurality of SVM cells, each SVM cell in electrical contact with and located at an intersection between a row and column, each SVM cell comprising a material wherein the coercivity is decreased upon an increase in temperature;

at least one reference SVM cell substantially similar to the SVM cells of the cross-point array, the reference SVM cell positioned in close proximity to the cross-point array;

at least one temperature sensor thermally coupled to each at least one reference SVM cell; and

a feedback controlled temperature controller receiving a reference voltage and receiving a feedback voltage from at least one temperature sensor when power is applied to the sensor coupled reference SVM cell, the feedback controlled temperature controller adjusting the applied power to minimize the difference between the feedback voltage and the reference voltage;

wherein substantially contemporaneously with the application and adjustment of power to the reference SVM cell, a substantially identical power is applied and adjusted to a selected cross-point array SVM cell .

21. The controlled temperature, thermal-assisted magnetic memory device of claim 20, wherein the at least one reference SVM cell is substantially identical to the SVM cells of the array.

22. The controlled temperature, thermal-assisted magnetic memory device of claim 20, wherein the ambient temperature of the reference SVM cell is substantially about the same as the ambient temperature of the array of SVM cells.

23. The controlled temperature, thermal-assisted magnetic memory device of claim 20, wherein the reference SVM cell is located within the array.

24. The controlled temperature, thermal-assisted magnetic memory device of claim 20, wherein the reference voltage represents a specific temperature.

25. The controlled temperature, thermal-assisted magnetic memory device of claim 20, wherein the feedback controlled temperature controller further includes a negative

feedback differential amplifier receiving the reference voltage and the feedback voltage.

26. The controlled temperature, thermal-assisted magnetic memory device of claim 20, wherein the applied power is a heating power.

27. The controlled temperature, thermal-assisted magnetic memory device of claim 20, wherein the reference SVM cell and selected array SVM cell self-heat by the power flowing through the reference SVM cell and selected array SVM cell.

28. The controlled temperature, thermal-assisted magnetic memory device of claim 20, wherein the reference SVM cell and selected array SVM cell are heated by coupled heating, wherein heating power flows through a separated heating device thermally coupled to the reference SVM cell and selected array SVM cell.

29. The controlled temperature, thermal-assisted magnetic memory device of claim 20, wherein the temperature sensor is a PN junction diode.

30. The controlled temperature, thermal-assisted magnetic memory device of claim 20, further including a circuit for heating a selected array SVM cell during a write operation on the selected array SVM cell, the circuit:

applying substantially the same power to the reference SVM cell and the selected array SVM cell;

sensing a feedback voltage from the temperature sensor coupled to the reference SVM cell;

adjusting the power applied to the reference SVM cell and the selected array SVM cell to minimize the difference between the feedback voltage and the reference voltage; and

applying a magnetic field to the selected array SVM cell;

wherein the orientation of magnetization of the selected array SVM cell may be changed, the magnetic field being greater than the coercivity of the heated selected array SVM cell.

31. The controlled temperature, thermal-assisted magnetic memory device of claim 20, wherein the reference SVM cell and array SVM cells each include:

at least one ferromagnetic data layer characterized by an alterable orientation of magnetization, the ferromagnetic data layer comprising a material wherein the coercivity is decreased upon an increase in temperature;

an intermediate layer in contact with the data layer; and

at least one ferromagnetic reference layer in contact with the intermediate layer, opposite from the data layer.

32. The controlled temperature, thermal-assisted magnetic memory device of claim 31, wherein the reference layer is a soft-reference layer.

33. A method of performing a write operation on a selected SVM cell in a controlled temperature, thermal-assisted magnetic memory device consisting of an array of SVM cells wherein their coercivity is decreased upon an increase in temperature, a reference SVM cell substantially similar to and in close proximity to the array, and a feedback controlled temperature controller having a temperature sensor thermally coupled to the reference SVM cell, the method comprising:

selecting a specific SVM cell from the array;

applying a first power to the reference SVM cell, the first power heating the reference SVM cell;

applying a second power, substantially identical to the first power, to the selected SVM cell, the second power heating selected SVM cell;

sensing a feedback voltage from the temperature sensor coupled to the reference SVM cell;

comparing the feedback voltage to a reference voltage;

adjusting the first power applied to the reference SVM cell to minimize the difference between the feedback voltage and the reference voltage;

adjusting the second power applied to the selected SVM cell to be substantially identical to the adjusted first voltage; and

applying a magnetic field to the selected SVM cell;

wherein the orientation of magnetization of the selected array SVM cell may be changed, the magnetic field being greater than the coercivity of the heated selected array SVM cell.

34. The method of claim 33, wherein the array is a cross-point array.

35. The method of claim 33, wherein the reference voltage represents a specific temperature.

36. The method of claim 33, wherein the reference voltage is predetermined.

37. The method of claim 33, wherein the reference voltage represents the temperature for a reduced coercivity of the selected SVM cell and reference SVM cell.

38. The method of claim 33, wherein the reference SVM cell and selected SVM cell self heat by the applied first power flowing through the reference SVM cell and the second power flowing through the selected SVM cell.

39. The method of claim 33, wherein the reference SVM cell and selected SVM cell are heated by coupled heating, wherein the first power flows through a separated heating device thermally coupled to the reference SVM cell and the second power flows through a separated heating device thermally coupled to the selected SVM cell.

40. The method of claim 33, wherein the ambient temperature of the reference SVM cell is substantially the same as the ambient temperature of the array of SVM cells.

41. The method of claim 33, wherein the reference SVM cell is within the array.

42. A computer system comprising:

a main board;

at least one central processing unit (CPU) coupled to the main board; and

at least one memory store joined to the CPU by the main board, the memory store including;

an array of SVM cells, the SVM cells characterized by an alterable orientation of magnetization and comprising a material wherein the coercivity is decreased upon an increase in temperature;

at least one reference SVM cell substantially similar to the SVM cells of the array, the reference SVM cell positioned within close proximity to the array;

at least one temperature sensor thermally coupled to each at least one reference SVM cell; and

a feedback controlled temperature controller receiving a reference voltage and feedback voltage from at least one temperature sensor when power is applied to the sensor coupled reference SVM cell and a selected array SVM cell to heat the reference SVM cell and a selected array SVM cell, the feedback controlled temperature controller adjusting the applied power to minimize the difference between the feedback voltage and reference voltage.

43. The computer system of claim 43, wherein the ambient temperature of the reference SVM cell is substantially about the same as the ambient temperature of the array of SVM cells.

44. The computer system of claim 43, wherein the reference voltage represents a specific temperature.

45. The computer system of claim 43, wherein the applied power is a heating power.